

## CHAPTER 1

# ADMINISTRATION AND ENFORCEMENT

### SECTION 101

#### SCOPE AND GENERAL REQUIREMENTS

**101.1 Title.** This code shall be known as the *International Energy Conservation Code* of [NAME OF JURISDICTION], and it shall be cited as such. It is referred to herein as “this code.”

**101.2 Intent.** This code regulates the design and construction of buildings to promote the effective use of energy in buildings. The provisions in this code are intended to provide flexibility to permit the use of innovative approaches and techniques to achieve effective use of energy. This code is not intended to abridge safety, health or environmental requirements under other applicable codes or ordinances.

**101.3 Compliance.** Compliance for residential buildings shall be determined based on Chapter 4. Compliance for commercial buildings shall be determined based on Chapter 5. Climate zones for compliance are defined in Chapter 3.

**101.4 Scope.** This code establishes minimum levels of energy efficiency for residential and commercial buildings.

**101.4.1 Exempt buildings.** The following buildings, or portions thereof separated by building envelope assemblies from the remainder of the building, shall be exempt from this code. Commercial building lighting and service water heating are not exempted.

1. Buildings that have a peak design rate of energy usage less than 3.4 Btu/h·ft<sup>2</sup> (10.7 W/m<sup>2</sup>) or 1.0 watt/ft<sup>2</sup> (10.7 W/m<sup>2</sup>) of floor area for all purposes.
2. Buildings that are neither mechanically heated nor mechanically cooled.
3. Buildings specifically classified as historically significant by the state or local jurisdiction, listed in *The National Register of Historic Places* or determined to be eligible for such listing.

**101.4.2 Applicability.** This code shall apply to buildings as set forth in Section 101. Where, in a specific case, different sections of this code specify different requirements, the most restrictive requirements shall govern.

**101.4.2.1 Existing installations.** Except as

otherwise provided for in this chapter, this code shall not require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing building system lawfully in existence at the time of the adoption of this code.

**101.4.2.2 Additions, alterations, renovations or repairs.** Additions, alterations, renovations or repairs to a building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portion(s) of the existing system to comply with this code. Additions, alterations or repairs shall not cause existing systems to become unsafe, hazardous or overloaded.

**101.4.2.3 Change in occupancy.** A change in building occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall require that the building be made to comply with this code unless otherwise approved by the building official. The building official shall certify that such building meets the intent of this code for the proposed new occupancy.

**101.4.3 Mixed occupancy.** Where a building houses more than one occupancy, each portion of the building shall conform to the requirements for the occupancy housed therein. Where an occupancy is less than 10 percent of the area of any floor of a building, the major occupancy shall be considered the building occupancy.

### SECTION 102

#### MATERIALS, SYSTEMS AND EQUIPMENT

**102.1 Identification.** Materials, systems and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this code.

**102.1.1 Building envelope insulation.** An R-value identification mark shall be applied by the manufacturer to each piece of building envelope insulation 12 inches (305 mm) or greater in width. Alternatively, the R-value of insulation products, not so marked and placed so as to be readily observed upon inspection, shall be certified by the insulation installer. The certification shall list the

type, manufacturer and R-value of insulation installed in each element of the building envelope. For blown or sprayed insulation, the initial installed thickness, settled thickness, settled R-value, installed density, coverage area and number of bags installed shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location within the building.

**102.1.1.1 Roof/ceiling insulation.** The thickness of blown in or sprayed roof/ceiling insulation shall be identified by thickness markers that are labeled in inches or centimeters installed at least one for every 300 ft<sup>2</sup> (28 m<sup>2</sup>) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers a minimum of 1 inch (25 mm) in height. Each marker shall face the attic access.

**102.1.2 Fenestration product rating.** U-factors of fenestration products (windows, doors and

skylights) shall be determined in accordance with NFRC 100 by an accredited, independent laboratory, and labeled and certified by the manufacturer. The solar heat gain coefficient (SHGC) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer.

Products lacking such a labeled U-factor shall be assigned a default U-factor from Table 102.1.2. Where a particular feature cannot be determined with reasonable certainty, the product shall not receive credit for that feature in the default U-factor. Where a composite of materials from two different product types is used, the product shall be assigned the higher U-factor.

**Table 102.1.2. Default Glazed Fenestration U-Factors**

| Frame Type   | Single Pane | Double Pane | Single-Pane Skylight | Double-Pane Skylight |
|--|-------------|-------------|----------------------|----------------------|
| Metal  | 1.20        | 0.80        | 1.60                 | 1.05                 |
| Metal with Thermal Break   | 1.10        | 0.65        | 1.45                 | 0.90                 |
| Wood, Vinyl, Fiberglass or Combinations (includes metal clad products) | 0.95        | 0.55        | 1.25                 | 0.80                 |
| Glass Block  | 0.60        |             |                      |                      |

**102.1.3 Duct distribution systems insulation.** An R-value identification mark shall be applied by the manufacturer in intervals of no greater than 3 feet to insulated flexible duct products showing the thermal performance R-value for the duct insulation (excluding air films, vapor retarders or other duct components).

**102.2 Installation.** All materials, systems and equipment required by this code shall be installed in accordance with the manufacturer's installation instructions.

**102.3 Maintenance information.** Instructions shall be furnished for equipment and systems that require preventive maintenance for efficient operation. Required regular maintenance shall be clearly stated and incorporated on a readily accessible label affixed to the equipment. This label shall include the title or publication number for the operation and maintenance manual for that

particular model and type of product.

**102.4 Insulation installation.** Insulating materials shall be installed such that the manufacturer's R-value mark is readily observable upon inspection.

**102.4.1 Protection of exposed foundation insulation.** Insulation applied to the exterior of foundation walls and the perimeter of slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches (153 mm) below grade.

**102.5 Equipment efficiency label.** Heating, cooling and service water heating equipment with equipment efficiency regulated as an AFUE, HSPF, SEER or EF shall have the efficiency specified on a label permanently attached to the equipment by the

manufacturer.

### SECTION 103 ALTERNATE MATERIALS—METHOD OF CONSTRUCTION, DESIGN OR INSULATING SYSTEMS

**103.1 General.** This code is not intended to prevent the use of any material, method of construction, design or insulating system not specifically prescribed herein, provided that such construction, design or insulating system has been approved by the building official as meeting the intent of the code.

Compliance with specific provisions of this code may be determined through the use of computer software, worksheets, compliance manuals and other similar materials when the building official has approved these materials as meeting the intent of this code.

A building certified by a national, state or local energy efficiency program to exceed the energy efficiency required by this code shall be considered in compliance with this code. To comply based on such a certification; the certifying program must be recognized to exceed this code by the state agency with building code or energy authority, or by the U.S. Department of Energy. The certifying program must also be acceptable to the building official.

### SECTION 104 CONSTRUCTION DOCUMENTS

**104.1 General.** Construction documents and other supporting data shall be submitted with each application for a permit. Where special conditions exist, the building official is authorized to require additional construction documents to be prepared by a registered design professional.

**Exception:** The building official is authorized to waive the requirements for construction documents or other supporting data if the building official determines such is not necessary to confirm compliance with this code.

**104.2 Information on construction documents.** Construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted when approved by the building official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed or as

determined by the building official. Details shall include, but are not limited to, insulation materials and their R-values; fenestration U-factors and SHGCs; system and equipment efficiencies, types, sizes and controls; duct sealing, insulation and location; and air sealing details.

### SECTION 105 INSPECTIONS

**105.1 General.** Construction or work for which a permit is required shall be inspected by the building official.

**105.2 Required approvals.** No work shall be done on any part of the building or structure beyond the point indicated in each successive inspection without first obtaining the written approval of the building official. No construction shall be concealed without inspection approval.

**105.3 Final inspection.** The building shall have a final inspection and approval when completed and ready for occupancy.

**105.4 Reinspection.** A building shall be reinspected when determined necessary by the building official.

### SECTION 106 VALIDITY

**106.1 General.** If a portion of this code is held to be illegal or void, such a decision shall not affect the validity of the remainder of this code.

### SECTION 107 REFERENCED STANDARDS

**107.1 General.** The standards, and portions thereof, referred to in this code and listed in Chapter 6 shall be considered part of the requirements of this code to the extent of such reference.

**107.2 Conflicting requirements.** When a section of this code and a section of a referenced standard from Chapter 6 specify different materials, methods of construction or other requirements, the provisions of this code shall apply.

## CHAPTER 2

# DEFINITIONS

### SECTION 201

#### GENERAL

**201.1 Scope.** Unless stated otherwise, the following words and terms in this code shall have the meanings indicated in this chapter.

**201.2 Interchangeability.** Words used in the present tense include the future; words in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural includes the singular.

**201.3 Terms defined in other codes.** Terms that are not defined in this code but are defined in the *International Building Code*, *ICC Electrical Code*, *International Fire Code*, *International Fuel Gas Code*, *International Mechanical Code*, *International Plumbing Code* or the *International Residential Code* shall have the meanings ascribed to them in those codes.

**201.4 Terms not defined.** Terms not defined by this chapter shall have ordinarily accepted meanings such as the context implies.

### SECTION 202

#### GENERAL DEFINITIONS

**ACCESSIBLE.** Admitting close approach because not guarded by locked doors, elevation or other effective means (see "Readily accessible").

**ADDITION.** An extension or increase in floor area or height of a building or structure.

**ALTERATION.** Any construction or renovation to an existing structure other than repair or addition that requires a permit. Also, a change in a mechanical system that involves an extension, addition or change to the arrangement, type or purpose of the original installation that requires a permit.

**APPROVED.** Approved refers to approval by the building official as the result of investigation and tests conducted by the building official, or by reason of accepted principles or tests by nationally recognized organizations.

**AUTOMATIC.** Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current

strength, pressure, temperature or mechanical configuration (see "Manual").

**BASEMENT WALL.** The opaque portion of a wall that encloses one side of a basement and has a below-grade wall area that is 50 percent or more of the total opaque and nonopaque area of that enclosing side.

**BUILDING.** Any structure used or intended for supporting or sheltering any use or occupancy.

**BUILDING ENVELOPE.** The elements of a building which enclose conditioned spaces and through which thermal energy is capable of being transferred: to or from the exterior; or to or from spaces exempted by the provisions of Section 101.4.1

**BUILDING OFFICIAL.** The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative.

**COMMERCIAL BUILDING.** All buildings that are not included in the definition of Residential Buildings.

**COMMERCIAL BUILDING, NON-RESIDENTIAL.** All Commercial Buildings except those defined in Commercial Buildings, Residential.

**COMMERCIAL BUILDING, RESIDENTIAL.** R-1 occupancy, R-2 occupancy more than three stories above grade, and R-4 occupancy more than three stories above grade.

**CONDITIONED FLOOR AREA.** The horizontal projection of the floors associated with the conditioned space.

**CONDITIONED SPACE.** Space within a building that is supplied with heating or cooling, that includes uninsulated ducts, or opens directly into a conditioned space.

**CRAWLSPACE WALL.** The opaque portion of a wall that encloses a crawl space and is partially or totally below grade.

**DEADBAND.** The temperature range in which no heating or cooling is used.

**DUCT.** A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

**DWELLING UNIT.** A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

**ECONOMIZER.** A ducting arrangement and automatic control system that allows a cooling supply fan system to supply outdoor air to reduce or

eliminate the need for mechanical refrigeration during mild or cold weather.

**ENERGY ANALYSIS.** A method for determining the annual energy use of the Proposed design and Standard design based on estimates of energy use.

**ENERGY COST.** The total estimated annual cost for purchased energy for the building.

**EXTERIOR WALL.** An above-grade wall, enclosing conditioned space, that is vertical or sloped at an angle of sixty (60) degrees or greater from the horizontal. Includes between-floor spandrels, peripheral edges of floors, roof and basement knee walls, dormer walls, gable end walls, walls enclosing a mansard roof, and basement walls.

**FENESTRATION.** Skylights, roof windows, vertical windows (whether fixed or moveable), opaque doors, glazed doors, glass block, and combination opaque/glazed doors.

**HEAT TRAP.** An arrangement of piping and fittings, such as elbows, or a commercially available heat trap that prevents thermosyphoning of hot water during standby periods.

**HEATED SLAB.** Slab-on-grade construction in which the heating elements or hot air distribution system is in contact with or placed within the slab or the subgrade.

**HUMIDISTAT.** A regulatory device, actuated by changes in humidity, used for automatic control of relative humidity.

**INFILTRATION.** The uncontrolled inward air leakage through cracks and interstices in any building element and around windows and doors of a building caused by the pressure effects of wind or the effect of differences in the indoor and outdoor air density or both.

**INSULATING SHEATHING.** An insulating board with a core material with having a minimum R-value of R-2.

**LABELED.** Devices, equipment, or materials to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items that attests to compliance with a specific standard.

**LISTED.** Equipment, appliances, assemblies or materials included in a list published by a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of production of listed equipment, appliances, assemblies or material, and whose listing states either that the equipment, appliances, assemblies, or material meets nationally recognized standards or has been tested and found suitable for use in a

specified manner.

**LOW-VOLTAGE LIGHTING.** Lighting equipment powered through a transformer such as a cable conductor, a rail conductor and track lighting.

**MANUAL.** Capable of being operated by personal intervention (see "Automatic").

**OCCUPANCY.** The purpose for which a building, or portion thereof, is utilized or occupied.

**PROPOSED DESIGN.** A description of the proposed building used to estimate annual energy use for determining compliance based on total building performance.

**READILY ACCESSIBLE.** Capable of being reached quickly for operation, renewal or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see "Accessible").

**REPAIR.** The reconstruction or renewal of any part of an existing building for the purpose of its maintenance.

**RESIDENTIAL BUILDING.** One- and two-family dwellings, townhouses, R-2 residential buildings three stories or less in height above grade and R-4 residential buildings three stories or less in height above grade.

**ROOF ASSEMBLY.** A system designed to provide weather protection and resistance to design loads. The system consists of a roof covering and roof deck or a single component serving as both the roof covering and the roof deck. A roof assembly includes the roof deck, vapor retarder, substrate or thermal barrier, insulation, vapor retarder and roof covering. A roof assembly is horizontal or sloped at an angle less than sixty (60) degrees from the horizontal.

**SCREW LAMP HOLDERS.** A lamp base that requires a screw-in-type lamp such as an incandescent or tungsten-halogen bulb.

**SERVICE WATER HEATING.** Supply of hot water for purposes other than comfort heating.

**SIMULATION TOOL.** An approved software program or calculation-based methodology that projects the annual energy use of a building.

**STANDARD DESIGN.** A version of the Proposed design that meets the minimum requirements of this code and is used to determine the maximum annual energy use requirement for compliance based on total building performance.

**STANDARD TRUSS.** Any construction that does not permit the roof/ceiling insulation to achieve the required R-value over the exterior walls.

**SKYLIGHT.** Glazing that is horizontal or sloped at an angle less than sixty (60) degrees (1.1 rad) from the horizontal.

**SUNROOM.** A one-story structure attached to a

dwelling, with a glazing area in excess of 40 percent of the gross area of the structure's exterior walls and roof.

**THERMAL ISOLATION.** Physical and space conditioning separation from conditioned spaces. For example, the separation between a sunroom addition and a dwelling unit by existing or new wall(s), doors and/or windows. To qualify as thermally isolated, the space shall be controlled as a separate zone for heating and cooling or conditioned by separate equipment.

**THERMAL RESISTANCE, R-VALUE.** The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area ( $\text{h}\cdot\text{ft}^2\cdot^\circ\text{F}/\text{Btu}$ ).

**THERMAL TRANSMITTANCE, U-FACTOR.** Commonly referred to as a U-factor. The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films ( $\text{Btu}/\text{h}\cdot\text{ft}^2\cdot^\circ\text{F}$ ) [ $\text{W}/(\text{m}^2\cdot\text{K})$ ].

**THERMOSTAT.** An automatic control device actuated by temperature and designed to be responsive to temperature.

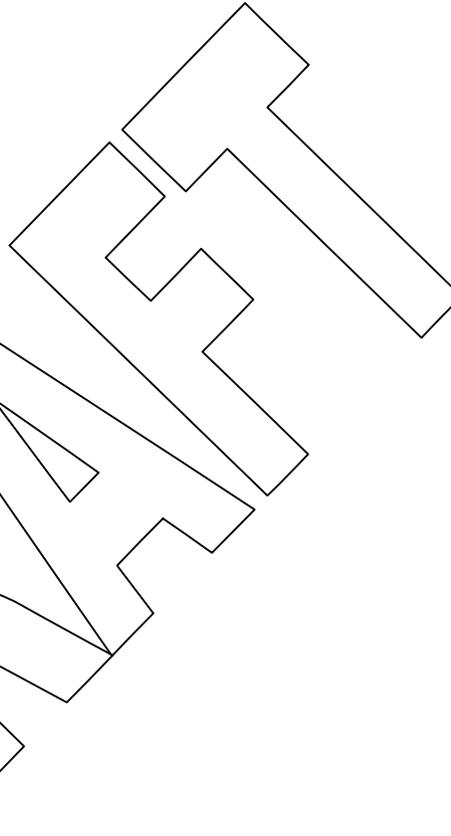
**TOWNHOUSE.** A building not more than three stories in height above grade consisting of multiple single-family dwelling units, constructed in a group of three or more attached units in which each unit extends from foundation to roof and with open space on at least two sides.

**VENTILATION.** The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

**VENTILATION AIR.** That portion of supply air that comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.

**WINDOW PROJECTION FACTOR.** A measure of the portion of glazing that is shaded by an eave or overhang. It is calculated as the ratio of an overhang's length (horizontal distance out from the glazing) to the vertical distance from the bottom of the glazing to the bottom of the overhang.

**ZONE.** A space or group of spaces within a building with heating or cooling requirements, or both, sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.



# CHAPTER 3 CLIMATE ZONES

## SECTION 301 CLIMATE ZONES

**301.1 General.** This chapter establishes the climate zones for use with Chapters 4 and 5.

Climate zone map goes here.



**Figure 301.1. Climate Zones**

**Table 301.1(1)**  
**CLIMATE ZONES BY STATE AND COUNTY**

**Alabama**

Zone 2 except  
Zone 1  
Baldwin  
Mobile

**Alaska**

Zone 7 except  
Zone 8  
Bethel  
Dellingham  
Fairbanks North Star  
Nome  
North Slope  
Northwest Arctic  
Southeast Fairbanks  
Wade Hampton  
Yukon-Koyukuk

**Arizona**

Zone 3 except  
Zone 2  
La Paz  
Maricopa  
Pima  
Pinal  
Yuma  
Zone 4  
Gila  
Yavapai  
Zone 5  
Apache  
Coconino  
Navajo

**Arkansas**

Zone 3 except  
Zone 4  
Baxter  
Benton  
Boone  
Carroll  
Fulton  
Izard  
Madison  
Marion  
Newton  
Searcy  
Stone  
Washington

**California**

Zone 3 Dry except  
Zone 2 Imperial  
Zone 3 Marine  
Alameda  
Marin  
Mendocino  
Monterey  
Napa  
San Benito  
San Francisco  
San Luis Obispo  
San Mateo  
Santa Barbara  
Santa Clara  
Santa Cruz  
Sonoma  
Ventura  
Zone 4 Dry  
Amador

Calaveras  
El Dorado  
Inyo  
Lake  
Mariposa  
Trinity  
Tuolumne  
Zone 4 Marine  
Del Norte  
Humboldt  
Zone 5  
Lassen  
Modoc  
Nevada  
Plumas  
Sierra  
Siskiyou  
Zone 6  
Alpine  
Mono

**Colorado**

Zone 5 except  
Zone 4  
Baca  
Las Animas  
Otero  
Zone 6  
Alamosa  
Archuleta  
Chaffee  
Conejos  
Costilla  
Custer  
Dolores  
Eagle  
Moffat  
Ouray  
Rio Blanco  
Saguache  
San Miguel  
Zone 7  
Clear  
Creek  
Grand  
Gunnison  
Hinsdale  
Jackson  
Lake  
Mineral  
Park  
Pitkin  
Rio Grande  
Routt  
San Juan  
Summit

**Connecticut**

Zone 5

**Delaware** Zone 4

**Dist Of Columbia**

Zone 4

**Florida**

Zone 2 except  
Zone 1  
Broward  
Dade  
Monroe

**Georgia**

Zone 3 except  
Zone 2  
Appling  
Atkinson  
Bacon  
Baker  
Berrien  
Brantley  
Brooks  
Bryan  
Camden  
Charlton  
Chatham  
Clinch  
Colquitt  
Cook  
Decatur  
Echols  
Effingham  
Evans  
Glynn  
Grady  
Jeff Davis  
Lanier  
Liberty  
Long  
Lowndes  
McIntosh  
Miller  
Mitchell  
Pierce  
Seminole  
Tattall  
Thomas  
Toombs  
Ware  
Wayne  
Zone 4  
Banks  
Catoosa  
Chattooga  
Dade  
Dawson  
Fannin  
Floyd  
Franklin  
Gilmer  
Gordon  
Habersham  
Hall  
Lumpkin  
Murray  
Pickens  
Rabun  
Stephens  
Towns  
Union  
Walker  
White  
Whitfield

**Hawaii**

Zone 1 Humid

**Idaho**

Zone 6 except  
Zone 5  
Ada  
Benewah

Canyon  
Cassia  
Clearwater  
Elmore  
Gem  
Gooding  
Idaho  
Jerome  
Kootenai  
Latah  
Lewis  
Lincoln  
Minidoka  
Nez Perce  
Owyhee  
Payette  
Power  
Shoshone  
Twin Falls  
Washington

**Illinois**

Zone 5 except  
Zone 4  
Alexander  
Bond  
Christian  
Clay  
Clinton  
Crawford  
Edwards  
Effingham  
Fayette  
Franklin  
Gallatin  
Hamilton  
Hardin  
Jackson  
Jasper  
Jefferson  
Johnson  
Lawrence  
Macoupin  
Madison  
Marion  
Massac  
Monroe  
Montgomery  
Perry  
Pope  
Pulaski  
Randolph  
Richland  
Saline  
Shelby  
St Clair  
Union  
Wabash  
Washington  
Wayne  
White  
Williamson

**Indiana**

Zone 5 except

Zone 4

Brown  
Clark  
Crawford  
Davies

Dearborn  
Dubois  
Floyd  
Gibson  
Greene  
Harrison  
Jackson  
Jefferson  
Jennings  
Knox  
Lawrence  
Martin  
Monroe  
Ohio  
Orange  
Perry  
Pike  
Posey  
Ripley  
Scott  
Spencer  
Sullivan  
Switzerland  
Vanderburgh  
Warrick  
Washington

**Iowa**

Zone 5 except

Zone 6

Allamakee  
Black Hawk  
Bremer  
Buchanan  
Buena Vista  
Butler  
Calhoun  
Cerro Gordo  
Cherokee  
Chickasaw  
Clay  
Clayton  
Delaware  
Dickinson  
Emmet  
Fayette  
Floyd  
Franklin  
Grundy  
Hamilton  
Hancock  
Hardin  
Howard  
Humboldt  
Ida  
Kossuth  
Lyon  
Mitchell  
O'Brien  
Osceola  
Palo Alto  
Plymouth  
Pocahontas  
Sac  
Sioux  
Webster  
Winnebago  
Winneshiek  
Worth  
Wright

**Kansas**

Zone 4 except

Zone 5  
Cheyenne  
Cloud  
Decatur  
Ellis  
Gove  
Graham  
Greeley  
Hamilton  
Jewell  
Lane  
Logan  
Mitchell  
Ness  
Norton  
Osborne  
Phillips  
Rawlins  
Republic  
Rooks  
Scott  
Sheridan  
Sherman  
Smith  
Thomas  
Trego  
Wallace  
Wichita

**Kentucky** Zone 4

**Louisiana**

Zone 2 except

Zone 3  
Bienville  
Bossier  
Caddo  
Caldwell  
Catahoulas  
Claiborne  
Concordia De Soto East  
Carroll  
Franklin  
Grant  
Jackson  
La Salle  
Lincoln  
Madison  
Morehouse  
Natchitoches  
Ouachita  
Red River  
Richland  
Sabine  
Tensas  
Union  
Vernon  
Webster  
West Carroll  
Winn

**Maine**

Zone 6 except

Zone 7 Aroostook

**Maryland**

Zone 4 except

Zone 5 Garrett

**Massachusetts**

Zone 5

**Michigan**

Zone 5 except

Zone 6

Alcona  
Alger  
Alpena  
Antrim  
Arenac  
Benzie  
Charlevoix  
Cheboygan  
Clare  
Crawford  
Delta  
Dickinson  
Emmet  
Gladwin  
Grand Traverse  
Huron  
Iosco  
Isabella  
Kalkaska  
Lake  
Leelanau  
Manistee  
Marquette  
Mason  
Mecosta  
Menominee  
Missaukee  
Montmorency  
Newaygo  
Oceana  
Ogemaw  
Oscoda  
Otsego  
Presque Isle  
Roscommon  
Sanilac  
Wexford  
Zone 7  
Baraga  
Chippewa  
Gogebic  
Houghton  
Iron  
Keweenaw  
Luce  
Mackinac  
Ontonagon  
Schoolcraft

**Minnesota**

Zone 6 except

Zone 7

Aitkin  
Becker  
Beltrami  
Carlton  
Cass  
Clay  
Clearwater  
Cook  
Crow Wing  
Grant  
Hubbard  
Itasca  
Kanabec  
Kittson  
Koochiching  
Lake Of The Woods  
Mahnomen  
Marshall  
Mille Lacs  
Norman

Otter Tail  
Pennington  
Pine  
Polk  
Red Lake  
Roseau  
St Louis  
Wadena  
Wilkin

**Mississippi**

Zone 3 except

Zone 2

Hancock  
Harrison  
Jackson  
Pearl River  
Stone

**Missouri**

Zone 4 except

Zone 5

Adair  
Andrew  
Atchison  
Buchanan  
Caldwell  
Chariton  
Clark  
Clinton  
Davies  
De Kalb  
Gentry  
Grundy  
Harrison  
Holt  
Knox  
Lewis  
Linn  
Livingston  
Macon  
Marion  
Mercer  
Nodaway  
Pike  
Putnam  
Ralls  
Schuyler  
Scotland  
Shelby  
Sullivan  
Worth

**Montana** Zone 6

**Nebraska** Zone 5

**Nevada**

Zone 5 except

Zone 3 Clark

**New Hampshire**

Zone 6 except

Zone 5

Cheshire  
Hillsborough  
Rockingham  
Strafford

**New Jersey**

Zone 4 except

Zone 5

Bergen  
Hunterdon  
Mercer  
Morris

Passaic  
Somerset  
Sussex  
Warren

**New Mexico**

Zone 4 except

Zone 3

Chaves  
Dona Ana  
Eddy  
Hidalgo  
Lea  
Luna  
Otero  
Zone 5  
Catron  
Cibola  
Cofax  
Harding  
Los Alamos  
McKinley  
Mora  
Rio Arriba  
San Juan  
San Miguel  
Sandoval  
Santa Fe  
Taos  
Torrance

**New York**

Zone 5 except

Zone 4

Bronx  
Kings  
Nassau  
New York  
Queens  
Richmond  
Suffolk  
Westchester

Zone 6

Allegany  
Broome  
Cattaraugus  
Chenango  
Clinton  
Delaware  
Essex  
Franklin  
Fulton  
Hamilton  
Herkimer  
Jefferson  
Lewis  
Madison  
Montgomery  
Oneida  
Otsego  
Schoharie  
Schuyler  
St Lawrence  
Steuben  
Sullivan  
Tompkins  
Ulster  
Warren  
Wyoming

**North Carolina**

Zone 3 except

Zone 4

Alamance  
Alexander

Bertie  
Buncombe  
Burke  
Caldwell  
Caswell  
Catawba  
Chatham  
Cherokee  
Clay  
Cleveland  
Davie  
Durham  
Forsyth  
Franklin  
Gates  
Graham  
Granville  
Guilford  
Halifax  
Harnett  
Haywood  
Henderson  
Hertford  
Iredell  
Jackson  
Lee  
Lincoln  
Macon  
Madison  
McDowell  
Nash  
Northampton  
Orange  
Person  
Polk  
Rockingham  
Rutherford  
Stokes  
Surry  
Swain  
Transylvania  
Vance  
Wake  
Warren  
Wilkes  
Yadkin  
Zone 5  
Alleghany  
Ashe  
Avery  
Mitchell  
Watauga  
Yancey

**North Dakota**

Zone 7 except

Zone 6

Adams  
Billings  
Bowman  
Burleigh  
Dickey  
Dunn  
Emmons  
Golden Valley  
Grant  
Hettinger  
La Moure  
Logan  
McIntosh  
McKenzie  
Mercer  
Morton  
Oliver

Ransom  
 Richland  
 Sargent  
 Sioux  
 Slope  
 Stark

**Ohio**

Zone 5 except

Zone 4

Adams  
 Brown  
 Clermont  
 Gallia  
 Hamilton  
 Lawrence  
 Pike  
 Scioto  
 Washington

**Oklahoma**

Zone 3 Humid except

Zone 4 Dry

Beaver  
 Cimarron  
 Texas

**Oregon**

Zone 5 Marine except

Zone 5 Dry

Baker  
 Crook  
 Deschutes  
 Gilliam  
 Grant  
 Harney  
 Hood River  
 Jefferson  
 Klamath  
 Lake  
 Malheur  
 Morrow  
 Sherman  
 Umatilla  
 Union  
 Wallowa  
 Wasco  
 Wheeler

**Pennsylvania**

Zone 5 except

Zone 4

Bucks  
 Chester  
 Delaware  
 Montgomery  
 Philadelphia  
 York

Zone 6

Cameron  
 Clearfield  
 Elk  
 McKean  
 Potter  
 Susquehanna  
 Tioga  
 Wayne

**Rhode Island**

Zone 5

**South Carolina**

Zone 3

**South Dakota**

Zone 6 except

Zone 5

Bennett  
 Bon Homme  
 Charles Mix  
 Clay  
 Douglas  
 Gregory  
 Hutchinson  
 Jackson  
 Mellette  
 Todd  
 Tripp  
 Union  
 Yankton

**Tennessee**

Zone 4 except

Zone 3

Chester  
 Crockett  
 Dyer  
 Fayette  
 Hardeman  
 Hardin  
 Haywood  
 Henderson  
 Lake  
 Lauderdale  
 Madison  
 McNairy  
 Shelby  
 Tipton

**Texas**

Zone 2 Humid except

Zone 2 Dry

Bandera  
 Dimmit  
 Edwards  
 Kinney  
 La Salle  
 Maverick  
 Medina  
 Real  
 Uvalde  
 Val Verde  
 Webb  
 Zapata  
 Zavala

Zone 3 Dry

Andrews  
 Baylor  
 Borden  
 Brewster  
 Callahan  
 Childress  
 Coke  
 Coleman  
 Collingsworth  
 Concho  
 Cottle  
 Crane  
 Crockett  
 Crosby  
 Culberson  
 Dawson  
 Dickens  
 Ector  
 El Paso  
 Fisher  
 Foard  
 Gaines  
 Garza  
 Glasscock  
 Hall

Hardeman  
 Haskell  
 Hemphill  
 Howard  
 Hudspeth  
 Irion  
 Jeff Davis  
 Jones  
 Kent  
 Kerr  
 Kimble  
 King  
 Knox  
 Loving  
 Lubbock  
 Lynn  
 Martin  
 Mason  
 Mcculloch  
 Menard  
 Midland  
 Mitchell  
 Motley  
 Nolan  
 Pecos  
 Presidio  
 Reagan  
 Reeves  
 Runnels  
 Schleicher  
 Scurry  
 Shackelford  
 Sterling  
 Stonewall  
 Sutton  
 Taylor  
 Terrell  
 Terry  
 Throckmorton  
 Tom Green  
 Ward  
 Wheeler  
 Wilbarger  
 Winkler  
Zone 3 Humid  
 Archer  
 Blanco  
 Bowie  
 Brown  
 Burnet  
 Camp  
 Cass  
 Clay  
 Collin  
 Comanche  
 Cooke  
 Dallas  
 Delta  
 Denton  
 Eastland  
 Ellis  
 Erath  
 Fannin  
 Franklin  
 Gillespie  
 Grayson  
 Gregg  
 Hamilton  
 Harrison  
 Henderson  
 Hood  
 Hopkins  
 Hunt  
 Jack

Johnson  
 Kaufman  
 Kendall  
 Lamar  
 Lampasas  
 Llano  
 Marion  
 Mills  
 Montague  
 Morris  
 Nacogdoches  
 Navarro  
 Palo  
 Pinto  
 Panola  
 Parker  
 Rains  
 Red  
 River  
 Rockwall  
 Rusk  
 Sabine  
 San Augustine  
 San Saba  
 Shelby  
 Smith  
 Somervell  
 Stephens  
 Tarrant  
 Titus  
 Upshur  
 Van Zandt  
 Wichita  
 Wise  
 Wood  
 Young  
Zone 4  
 Armstrong  
 Bailey  
 Briscoe  
 Carson  
 Castro  
 Cochran  
 Dallam  
 Deaf Smith  
 Donley  
 Floyd  
 Gray  
 Hale  
 Hansford  
 Hartley  
 Hockley  
 Hutchinson  
 Lamb  
 Lipscomb  
 Moore  
 Ochiltree  
 Oldham  
 Parmer  
 Potter  
 Randall  
 Roberts  
 Sherman  
 Swisher  
 Yoakum

**Utah**

Zone 5 except

Zone 3 Washington

Zone 6

Box Elder  
 Cache  
 Carbon  
 Daggett

Duchesne  
 Morgan  
 Rich  
 Summit  
 Uintah  
 Wasatch

**Vermont** Zone 6

**Virginia** Zone 4

**Washington**

Zone 5 Marine except

Zone 5 Dry

Adams  
 Asotin  
 Benton  
 Chelan  
 Columbia  
 Douglas  
 Franklin  
 Garfield  
 Grant Island  
 Kittitas  
 Klickitat  
 Lincoln  
 San Juan  
 Skamania  
 Spokane  
 Walla Walla  
 Whitman  
 Yakima

Zone 6 Dry

Ferry  
 Okanogan  
 Pend  
 Oreille  
 Stevens

**West Virginia**

Zone 5 except

Zone 4

Berkeley  
 Boone  
 Braxton  
 Cabell  
 Calhoun  
 Clay  
 Gilmer  
 Jackson  
 Jefferson  
 Kanawha  
 Lincoln  
 Logan  
 Mason  
 McDowell  
 Mercer  
 Mingo  
 Monroe  
 Morgan  
 Pleasants  
 Putnam  
 Ritchie  
 Roane  
 Tyler  
 Wayne  
 Wirt  
 Wood  
 Wyoming

**Wisconsin**

Zone 6 except

Zone 7

Ashland  
 Bayfield

Burnett  
Douglas  
Florence  
Forest  
Iron

Langlade  
Lincoln  
Oneida  
Price  
Sawyer

Taylor  
Vilas  
Washburn  
**Wyoming**

Zone 6 except  
Zone 5  
Goshen  
Platte  
Zone 7

Lincoln  
Sublette  
Teto

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## CHAPTER 4

# RESIDENTIAL ENERGY EFFICIENCY

### SECTION 401 GENERAL

**401.1 Scope.** This chapter contains the energy efficiency requirements for residential buildings.

**401.2 Compliance.** Compliance with energy efficiency requirements for residential buildings shall be demonstrated by meeting the applicable provisions of this chapter.

**401.3 Certificate.** A permanent certificate shall be posted inside the building on the electrical distribution panel. The certificate shall list the predominant R-values for ceiling/roof, walls, foundation (slab, basement wall, crawlspace wall and/or floor, including all present) and ducts outside conditioned spaces; U-factors for each fenestration type present; and, for Zones 1 through 3, the solar heat gain coefficient (SHGC) of fenestration. The certificate shall list the type and efficiency of heating, cooling and service water heating equipment.

### SECTION 402 BUILDING ENVELOPE

**402.1 Insulation and fenestration criteria.** The building envelope shall meet the requirements of either Table 402.1(1) or Table 402.1(2), except as stated in this Section. As an alternative, compliance may be demonstrated by meeting the requirements in Table 402.1(3).

**402.1.1 R-value computation.** When more than one insulation material is used in layers, such as framing cavity insulation and insulating sheathing, the sum of the insulation R-values shall meet or exceed the minimum required R-value in Table 402.1(1). The manufacturer's settled R-value shall be used as the R-value of blown insulation. Insulation separated from the conditioned space by a vented space is not included in the R-value computation. Framing, drywall, structural sheathing, exterior siding, air films and enclosed cavities shall not be counted towards the minimum required R-value, but may be included in a U-factor calculation for Section 402.1.2.

**402.1.2 UA-based compliance alternative.** A residential building with a total conditioned building envelope UA (U-factor times area) that is less than or equal to the total UA using Table 402.1(2) and assuming identical component areas complies with those same envelope requirements. The UA calculation shall be done using a method approved by the building official. The SHGC requirements must be met in addition to the UA compliance.

#### 402.2 Insulation for specific situations.

**402.2.1 Ceilings.** R-30 meets the requirement for R-38 whenever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. R-38 meets the requirement for R-49 whenever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves.

**402.2.2 Cathedral ceilings.** The minimum required cathedral or vaulted ceiling insulation is R-30 in all climate zones.

**402.2.3 Mass walls.** Mass walls include concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (not brick veneer) and log walls. To use the mass wall provisions, greater than 50% of the insulation R-value shall be on the exterior of, or integral to, the mass wall. Mass walls that do not meet this criterion for insulation placement shall meet the frame wall insulation requirements.

**402.2.4 Steel-frame ceilings, walls and floors.** Table 402.2.4 provides the minimum R-values for steel-frame ceilings, walls and floors. Alternately, steel-frame walls may meet frame wall U-factor requirements in Table 402.1(2). Any calculated steel-frame wall U-factor shall use a series-parallel path calculation method.

**402.2.5 Opaque doors.** A door with a foam core shall be deemed to meet the required fenestration U-factor. One opaque door assembly is exempted from the U-factor requirement.

**402.2.6 Floors.** Floor insulation shall be installed to maintain permanent contact with the floor above.

**402.2.7 Basement walls.** In unconditioned basements, either the insulation requirements for basement walls or the floors separating the basement from conditioned space shall be met. Basement wall insulation shall extend from the top of the basement wall down to 10 feet below grade or to the basement floor, whichever is less.

**402.2.8 Cantilevered floors, floors over outside air and dormer ceilings.** Cantilevered floors, floors over outside air, and dormer ceilings shall require R-30 insulation or insulation sufficient to fill the framing cavity.

**402.2.9 Slab-on-grade floors.** Above-grade slabs and slabs whose top is within 12 inches of grade shall be insulated as required in Table 402.1(1). Slab insulation shall extend downward from the top of the slab on the outside of a foundation or on the inside of a foundation wall. Insulation below grade can be extended the required distance by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the slab. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab may be cut at a 45-degree angle away from the exterior wall.

**402.2.10 Crawl space walls.** Where the floor above the crawl space is uninsulated, any required insulation shall be installed on crawl space walls and the crawl space shall be unvented to the outside. The required insulation shall extend downward from the sill plate to the exterior finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Crawl space wall insulation shall be permanently fastened to the crawl space wall. The exposed earth in unvented crawl space foundations shall be covered with a continuous vapor retarder having a maximum permeance rating of 1 perm when tested according to ASTM E 96. All joints in the vapor retarder shall be sealed. The edges of the vapor retarder shall extend at least 6 inches up the stem wall and shall be attached to the stem wall.

**402.2.10 Masonry veneer.** Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

**402.3 Fenestration U-factor and SHGC.** The U-

factor and/or SHGC requirements may be met based on an area-weighted average of individual elements of the fenestration.

**402.3.1 Fenestration SHGC exemptions.** The following are exempt from the SHGC requirements:

1. Any fenestration facing within 45 degrees of true south with an overhang having a window projection factor of 0.3 or more.
2. Any double-pane fenestration where the air conditioning SEER is raised 3 above the SEER that would otherwise be required.

**402.3.2 Fenestration exemption.** Up to 15 ft<sup>2</sup> of glazed fenestration per dwelling unit is exempt from U-factor and SHGC requirements.

**402.3.3 Thermally isolated sunrooms.**

Thermally isolated sunrooms shall be required to have a maximum glazed fenestration U-factor of 0.50 in Zones 4 through 8. Thermally isolated sunrooms are exempt from the fenestration SHGC requirements. The minimum ceiling R-value shall be R-19 in zones 1 through 3 and R-24 in zones 4 through 8. The minimum wall R-value shall be R-13 in all zones. Sunrooms shall otherwise meet the requirements of this chapter.

**402.3.4 Replacement fenestration.** Where some or all of an existing fenestration unit is replaced with an entire new replacement fenestration product, including frame, sash, and glazed portion, the replacement fenestration unit shall meet the requirements for U-factor and SHGC.

**402.3.4 Impact resistant fenestration.**

Jurisdictions in zones 1 through 4 that require impact resistant fenestration that meets ASTM E-1886 or ASTM E-1996, are exempt from the fenestration U-factor requirement. Fenestration so exempted shall be labeled by the manufacturer as meeting ASTM E-1886 or ASTM E-1996.

**402.4 Air leakage.**

**402.4.1 Building envelope.** The building envelope shall be durably sealed to limit uncontrolled air movement between conditioned spaces and either unconditioned spaces or the outside. Seals between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weatherstripped or otherwise sealed:

1. All joints, seams and penetrations.
2. Site-built windows, doors and skylights.

3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Dropped ceilings or chases.
6. Knee walls.
7. Walls and ceilings separating the garage from interior conditioned spaces.
8. Behind tubs and showers on exterior walls.
9. Common walls between dwelling units.
10. Other sources of air leakage through the building thermal envelope.

**402.4.2 Fenestration air leakage.** Manufactured windows, skylights and sliding-glass doors shall have an air infiltration rate of no more than 0.3 cfm/ft<sup>2</sup>. Swinging doors shall have an air infiltration rate of no more than 0.5 cfm/ft<sup>2</sup>. The air leakage of manufactured fenestration shall be determined according to NAFS-1, NFRC 400, or AAMA/WDMA 101/I.S.2 by an accredited, independent laboratory and certified on a label attached by the manufacturer to the fenestration.

**Exemptions:** Site-built windows, skylights and doors.

**402.4.3 Recessed lighting.** When installed in the building envelope, recessed lighting fixtures shall be sealed to limit air leakage between conditioned and unconditioned space. The fixtures shall meet one of the following requirements:

1. IC-rated with enclosures that have no penetrations to the ceiling cavity. Enclosures are sealed or gasketed to prevent air leaks to ceiling cavity or unconditioned space.
2. IC-rated and meet ASTM E 283 with no more than 2.0 cubic feet per minute (cfm) (0.944 L/s) air movement from the conditioned space to the ceiling cavity. The lighting fixture shall be tested at 1.57 psi (75 Pa) pressure difference and shall be labeled.
3. Inside airtight sealed box at least 0.5 inches (12.7 mm) from combustible material and 3 inches (76mm) from insulation.

**402.5 Moisture control.** The design shall not create conditions of accelerated deterioration from moisture condensation. Frame walls, floors and ceilings not ventilated to allow moisture to escape shall be provided with an approved vapor retarder having a maximum permeance rating of 1.0 perm (5.72 × 10<sup>-8</sup> g/Pa·s·m<sup>2</sup>) when tested in accordance with Procedure A of ASTM E 96. The vapor retarder shall be installed on the warm-in-winter side of the thermal insulation.

**Exceptions:**

1. In construction where moisture or its freezing will not damage the materials.
2. Frame walls, floors and ceilings in jurisdictions in Zones 1 through 5.<sup>a</sup>
3. Where other approved means to avoid condensation are provided.

## SECTION 403 SYSTEMS

**403.1 Controls.** At least one thermostat shall be provided for each separate heating, cooling or combination heating and cooling system.

### 403.2 Ducts.

**403.2.1 Insulation.** Ducts in unconditioned spaces, such as unconditioned attics, vented crawl spaces, unconditioned basements, garages, spaces outside the building or spaces within a building envelope assembly, shall be insulated to a minimum of R-8.

**Exception:** Portions of the air distribution system within appliances or equipment.

**403.2.2 Sealing.** All ducts, air handlers, filter boxes, or building cavities used to convey conditioned air shall be sealed, including those in conditioned spaces. Longitudinal and transverse joints, seams and connections of supply and return ducts shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or mechanical fasteners.

**403.2.2.1 Tapes.** Tapes are prohibited as sealants.

**Exceptions:**

1. UL 181A listed and labeled tape when used to seal rigid fibrous glass ducts (duct board).
2. UL 181B listed and labeled tape is used to seal flexible air duct.

**403.2.3 Building cavities.** Building framing cavities, such as the spaces between joists in walls or floors, shall not be used as supply ducts.

**403.2.4 Construction.** Ductwork shall be constructed in accordance with the *International Mechanical Code*.

### 403.3 Mechanical system piping insulation.

Mechanical system piping shall be insulated to a minimum of R-2 for pipes ½-inch and less, and to a

(a) Crawl space floor vapor retarders are still required in unvented crawl spaces.

minimum of R-4 for pipes greater than ½-inch.

**Exception:** Piping installed within appliances and equipment or piping that conveys fluids between 55°F (13°C) and 120°F (49°C).

**403.4 Circulating hot water systems.** Circulating service hot water pipes in conditioned or unconditioned spaces shall be insulated to a minimum of R-2. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

**403.5 Mechanical ventilation.** Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

## SECTION 404 PERFORMANCE ALTERNATIVE

**404.1 Scope.** This Section establishes design criteria in terms of the overall energy performance of a residential building.

### 404.2 Equivalent energy performance.

**404.2.1 Mandatory requirements.** Compliance with this Section requires that the criteria of Section 401 be met.

**404.2.2 Performance comparison.** Compliance based on performance requires that a proposed building design ("proposed design") be shown to have an annual energy use less than or equal to that of a similar house ("standard design") built to exactly comply with the minimum requirements of Sections 402 and 403. "Energy use" means either:

1. The annual energy used by the building for heating, cooling, and water heating, with different fuels accounted at the building site, and assuming 1 kWh = 3,413 BTU; or
2. The annual energy cost for heating, cooling, and water heating, with energy prices taken from a source approved by the building official, such as the Department of Energy's State Energy Price and Expenditure Report.

### 404.3 Calculation procedure.

**404.3.1 Proposed Design.** The proposed design shall represent the actual structure and systems of the building planned for construction.

**Exception:** The proposed design shall be assumed

to be heated, cooled, and include service water heating.

**404.3.2 Standard design.** The standard design shall be identical to the proposed design except that the standard design shall be assumed to have the minimum allowable values specified in Sections 402 and 403. The similarity shall include at least the following:

1. The two designs shall utilize the same operational schedules, thermostat settings, and weather/climate data.
2. The two designs shall have the same conditioned floor area and surface areas bounding the conditioned space(s).
3. The two designs shall have the same glazed area, oriented identically.
4. The two designs shall use the same energy sources for the same functions.

#### Exceptions:

1. The equipment efficiencies shall be the minimum allowed by Federal law.
2. If the proposed design includes solar service water heating, the water heater in the standard design shall use the same fuel as the space heating system.
3. If the proposed design includes electric heating, the standard design shall use an air-source heat pump with the minimum efficiency allowed by Federal law.
4. If the proposed design includes improved duct insulation and/or leakage control, the standard design shall assume <TBD> [to be determined]. Any proposed reduction in leakage shall be verified by a pressure-flow test according to <TBD>.
5. If the standard design includes improved air-infiltration measures, the standard design shall assume an air infiltration rate of <TBD> ACH. The proposed design infiltration rate shall be verified by a house pressure-flow test.

### 404.3.3 Minimum scope of calculation procedure.

Any calculation procedure used to comply with this Section shall be capable of calculating the annual energy consumption of all building elements that differ between the standard and proposed designs.

### 404.4 Calculation and software tools.

**404.4.1 Approved tools.** Performance analysis tools must be approved by the building official. Tools may be approved based on meeting a specified threshold for a jurisdiction, such as a home-energy-rating tool requiring a specified score.

The building official may also approve tools for a specified application or limited scope; such as a tool approved only for building envelop tradeoffs or a tool that was not approved for SHGC tradeoffs. Tools certified by the ICC Evaluation Service to meet the requirements of this Section shall be acceptable.

**404.4.2 Input values.** When calculations require input values for building elements, other than those regulated by Sections 402 and 403, that do not differ between the standard and proposed design, those input values shall be taken from Table <TBD> or another source approved by the building official.

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**Table 402.1(1). Insulation and Glazed Fenestration Requirements<sup>(a)</sup>**

| Climate Zone | Fenestration U-Factor | Skylight U-Factor <sup>(b)</sup> | Fenestration SHGC   | Ceiling R-Value <sup>(c)</sup> | Frame Wall R-Value <sup>(d)</sup> | Mass Wall R-Value | Floor R-Value     | Basement <sup>(e)</sup> Wall R-Value | Slab <sup>(f)</sup> R-Value & Depth | Crawl Space <sup>(g)</sup> Wall R-Value |
|--------------|-----------------------|----------------------------------|---------------------|--------------------------------|-----------------------------------|-------------------|-------------------|--------------------------------------|-------------------------------------|---|
| 1            | 1.20                  | 1.60                             | 0.40                | 30                             | 13                                | 6                 | 13                | 0                                    | 0                                   | 0                                       |
| 2            | 0.80                  | 1.05                             | 0.40                | 30                             | 13                                | 6                 | 13                | 0                                    | 0                                   | 0                                       |
| 3            | 0.65                  | 0.90                             | 0.40 <sup>(h)</sup> | 30                             | 13                                | 6                 | 19                | 0                                    | 0                                   | 5/13                                    |
| 4            | 0.40                  | 0.60                             | NR                  | 38                             | 13 <sup>(i)</sup>                 | 8                 | 19                | 10 / 13                              | 10, 2 ft                            | 10 / 13                                 |
| 5            | 0.35                  | 0.60                             | NR                  | 38                             | 19 or 13+5                        | 13                | 25 <sup>(i)</sup> | 10 / 13                              | 10, 2 ft                            | 10 / 13                                 |
| 6            | 0.35                  | 0.60                             | NR                  | 49                             | 19 or 13+5                        | 15                | 30 <sup>(i)</sup> | 10 / 13                              | 10, 4 ft                            | 10 / 13                                 |
| 7 and 8      | 0.35                  | 0.60                             | NR                  | 49                             | 21                                | 21                | 30 <sup>(i)</sup> | 15 / 21                              | 15, 4 ft                            | 10 / 13                                 |

- (a) R-values are minimums. U-factors are maximums. Fenestration U-factor and SHGC refer to the whole fenestration unit. R-values in this table are uncompressed R-values. Ceiling insulation at the eaves and R-19 insulation in 2x6 walls may be compressed. Steel-frame wall R-values are given in Table 402.2.4. Fenestration includes doors.
- (b) The fenestration U-factor column excludes skylights; this column applies only to skylights. The SHGC column applies to all glazed fenestration. Skylights are glazed fenestration less than 60 degrees from horizontal.
- (c) Insulation may be applied to the underside of the roof if the attic is air sealed and unvented.
- (d) Frame walls include between-floor spandrels, peripheral edges of floors, roof and basement knee walls, dormer walls, gable end walls and walls enclosing a mansard roof.
- (e) A basement wall is any individual wall that is more than 50% below grade. The first R-value applies to continuous insulation the second to insulation in a framing cavity; either meets the basement requirement.
- (f) Slab-edge insulation is not required in jurisdictions designated by the building official as having a very heavy termite infestation. R-5 shall be added to the required slab edge R-values for heated slabs.
- (g) The first R-value applies to continuous insulation, the second to insulation that fills a framing cavity; either one meets the crawl space wall insulation requirement.
- (h) There are no SHGC requirements in the Marine zone.
- (i) Or insulation sufficient to fill the framing cavity, R-19 minimum.
- (j) "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If the structural sheathing covers 25% or less of the exterior, R-5 sheathing not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.

**Table 402.1(2). Equivalent U-Factors<sup>(a)</sup>**

| Climate Zone | Fenestration U-Factor | Skylight U-Factor | Ceiling U-Factor | Frame Wall U-Factor | Mass Wall U-Factor | Floor U-Factor | Basement Wall U-Factor | Crawl Space Wall U-Factor |
|--------------|-----------------------|-------------------|------------------|---------------------|--------------------|----------------|------------------------|---------------------------|
| 1            | 1.20                  | 1.60              | 0.035            | 0.082               | 0.110              | 0.064          | 0.360                  | 0.477                     |
| 2            | 0.80                  | 1.05              | 0.035            | 0.082               | 0.110              | 0.064          | 0.360                  | 0.477                     |
| 3            | 0.65                  | 0.90              | 0.035            | 0.082               | 0.110              | 0.047          | 0.360                  | 0.136                     |
| 4            | 0.40                  | 0.60              | 0.030            | 0.082               | 0.099              | 0.047          | 0.059                  | 0.065                     |
| 5            | 0.35                  | 0.60              | 0.030            | 0.060               | 0.082              | 0.037          | 0.059                  | 0.065                     |
| 6            | 0.35                  | 0.60              | 0.026            | 0.060               | 0.077              | 0.033          | 0.059                  | 0.065                     |
| 7 and 8      | 0.35                  | 0.60              | 0.026            | 0.057               | 0.057              | 0.033          | 0.041                  | 0.057                     |

(a) Insulated building envelope U-factors must be obtained from measurement or calculation.

Table 402.2.4. Steel-Frame Ceiling, Wall and Floor Insulation (R-Value)

|                     |   |
|---------------------|---|
| <b>Climate Zone</b> | <b>Wall Insulation R-Value (Cavity + Sheathing)</b>         |
| TBD                 | TBD   |
|                     | <b>Roof/Ceiling Insulation R-Value (Cavity + Sheathing)</b> |
| TBD                 | TBD   |
|                     | <b>Floor Insulation R-Value (Cavity + Sheathing)</b>        |
| TBD                 | TBD   |
| Footnotes- TBD      |   |

DRAFT

**Table 402.1(3). Alternative Insulation and Glazed Fenestration Requirements**

| Climate Zone     | Shall Meet ONE or MORE of the Following Conditions                          | Fenestration U-Factor  | Skylight U-Factor      | Fenestration SHGC | Ceiling R-Value | Frame Wall R-Value | Mass Wall R-Value | Floor R-Value | Basement Wall R-Value <sup>(b)</sup>             | Slab <sup>(c)</sup> R-Value | Crawl Space Wall R-Value |
|------------------|---|------------------------|------------------------|-------------------|-----------------|--------------------|-------------------|---------------|--|-----------------------------|--------------------------|
| <b>All zones</b> | Ducts & HVAC in conditioned space <sup>(a)</sup><br>Ground source heat pump |                        |                        |                   |                 |                    |                   |               |  |                             |                          |
| 2                | SEER TBD <sup>(d)</sup>   | <b>Any</b>             | <b>Any</b>             | 0.40              | 30              | 13                 | 6                 | 13            | 0  | 0                           | 0                        |
| 3                | SEER TBD1 <sup>(d)</sup> with AFUE 90<br>SEER TBD with HSPF 7.9             | <b>Any double pane</b> | <b>Any double pane</b> | 0.40              | 30              | 13                 | 6                 | <b>13</b>     | 0  | 0                           | <b>0</b>                 |
| 4                | SEER TBD with AFUE 90<br>SEER TBD with HSPF 7.9                             | <b>0.65</b>            | <b>0.90</b>            | NR                | <b>30</b>       | <b>13</b>          | 8                 | 19            | 10/13  | 10, 2 ft                    | 10/13                    |
| 4                | SEER TBD with AFUE 90<br>SEER TBD with HSPF 7.9                             | 0.40                   | 0.60                   | NR                | 38              | 19 or 13+5         | 13                | <b>13</b>     | <b>Unconditioned 0</b><br><b>Conditioned 5/5</b> | <b>0</b>                    | 10/13                    |
| 5                | SEER TBD with AFUE 90<br>SEER TBD with HSPF 7.9                             | 0.35                   | 0.60                   | NR                | 38              | <b>13</b>          | <b>8</b>          | 25            | 10/13  | 10, 2 ft                    | 10/13                    |
| 5                | SEER TBD with AFUE 90<br>SEER TBD with HSPF 7.9                             | 0.35                   | 0.60                   | NR                | 38              | 19 or 13+5         | 13                | <b>19</b>     | <b>Unconditioned 0</b><br>Conditioned 10/13      | <b>0</b>                    | <b>10/13</b>             |
| 6                | SEER TBD with AFUE 90<br>SEER TBD with HSPF 8.2                             | 0.35                   | 0.60                   | NR                | <b>38</b>       | <b>13</b>          | <b>10</b>         | 30            | 10/13  | 10, 4 ft                    | 10/13                    |
| 7                | AFUE 90<br>HSPF 8.2   | 0.35                   | 0.60                   | NR                | <b>38</b>       | <b>15</b>          | <b>15</b>         | 30            | 15/19  | 15, 4 ft                    | 15/21                    |

Bold type indicates requirements that differ from Table 402.1(1).

In zones 3 through 8 dwelling units with electric resistance heating are not eligible to use this table.

All footnotes of Table 402.1(1) apply.

After the year 2006 change: SEER increased by 2 from value in table; HSPF from 7.9 to 8.5; and HSPF from 8.2 to 8.8.

(a) Air-handler and furnace shall be in conditioned space. A factory-sealed air handlers tested, certified and labeled by the manufacturer to have achieved a 2 percent or less leakage rate at 1.0 inch water gauge shall meet the requirement for the air handler being in conditioned space.

(b) For uninsulated unconditioned basements in Zones 4 and 5, only one foot or less of the basement wall can be above grade for tradeoffs in this table.

(c) Slabs with uninsulated hot water pipes, uninsulated air distribution ducts or electric heating cables installed within or under the slab are not eligible for the tradeoff of slab-edge insulation.

(d) Evaporative cooling meets SEER requirement if building official has deemed evaporative cooling appropriate to the climate of the jurisdiction.